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Constraints to Private Investment in a High-Growth Environment: Firm-level Evidence from Ethiopia

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Abstract

Private investment remains relatively weak in Sub-Saharan Africa despite recent improvements in investment opportunities and infrastructure. The median firm in nine African countries has zero investment in any given year since 2005, similar to observations in the early 1990s when most economies in the region were performing poorly. To better understand this outcome, this paper analyzes investment decisions of a panel of Ethiopian firms using initial bank ties and firm size to capture heterogeneity in potential credit constraints. We find that relationships with lenders are persistent and firms with rare access to credit respond vigorously to investment opportunities than constrained ones. Credit access also shortens average durations of investment inaction and lackluster investment episodes. While access to credit increases with firm size, small firms with bank ties are at least as responsive to investment opportunities as large firms are. Such relationships tend to be particularly relevant for import competing and single-product firms that are prone to liquidity constraints as compared to their protected and multi-product counterparts.

Key World: Financing Constraints, Firm-level Investment, Bank Ties, Lumpy Investment; Ethiopia.

JEL: E22, E44, G30, O16.

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1. Introduction

African countries have achieved strong economic performance since the year 2000, reversing the economic malfunction that characterized most of the region's post-independence era. Per capita GDP grew by about 3 per cent per annum in Sub-Saharan Africa during this period mainly due to high commodity prices, large inflows of aid and foreign direct investment, and better macroeconomic management. However, concerns remain about the sustainability of rapid growth in Africa for a number of reasons including lack of structural transformation, economic slowdown in China and other major economies and the fragility of African political institutions (Miguel, 2009; Rodrik, 2014; ACET 2014). This paper provides a microeconomic perspective on sustainability of strong growth in Sub-Saharan Africa by focusing on the responsiveness of private investment to improvements in aggregate demand and infrastructural services; factors that have been known for stifling the size and investment rates of African firms particularly in the manufacturing sector (Collier, 2000; Tybout, 2000). Existing evidence on the investment behavior of African firms, however, comes from the early to mid 1990s when most economies in the region were performing poorly (Bigsten et al., 1999, 2005; Pattilo,1999). These studies find lackluster investment activities among African firms with a median investment rate close to zero.[1] Now that African economies are growing faster, one would expect domestic private investment to intensify. However, data from the World Bank's Enterprise Survey in eight African countries during 2006-2014 reveal that 40 to 60 per cent of firms still have zero investment spending at any given point in time (See Table 1). Table 1 also shows that the incidence of zero investment is more prevalent among firms without access to

[1] Zero investment rates are very rare among developed country firms (Bigsten et al., 1999).

credit. Given the centrality of investment for economic growth, these observations deserve a closer examination.

This paper uses a unique panel of privately owned Ethiopia manufacturing firms during the period 1996-2007 to examine heterogeneity in investment responses to improved business opportunities. Ethiopia is one of the fastest growing economies in Africa with an average GDP growth rate of about 10 per cent per annum since the early 2000s driven primarily by public investment in infrastructure (World Bank, 2009). Nonetheless, Table 2 shows relatively weak private investment rates in Ethiopia similar to observations in Table 1 for other African countries. The paper focuses on the role of access to external finance on firms' investment decisions given the apparent relaxation of demand and infrastructure constraints. In addition to the panel dimension of our data that allows us to control for firm fixed effects, we observe a significant reduction in private sector borrowing from the banking system during 2001-2011 that does not seem to arise from systemic adverse shocks in Ethiopia's nonfinancial sector. The reduction in credit supply rather resulted from increased borrowing by the state and state-owned enterprises as well as tougher regulations on private banks (World Bank, 2009; Zewdu 2014). Aggregate changes in credit constraints that firms in our sample encountered are thus largely exogenous to their real performances.

To estimate firm-level effects of this policy induced change in credit constraints, we exploit cross-firm variation in initial relationships with financial intermediaries that may generate differential probabilities of credit access subsequently. This approach is based on the assumption that borrower-lender relationships tend to be persistent for which we will provide

supportive evidence shortly. In an influential paper, Chodorow-Reich (2014) applies a similar empirical strategy where he finds that US firms that borrowed from financially less healthy lenders before the Great Recession experienced deeper cuts in employment during 2008-2009 as compared to those who borrowed from healthier banks. These effects are particularly stronger for small and medium size firms as compared to large firms. These findings underscore the role of financial frictions where there are switching costs for borrowers and they are consistent with theoretical models of financial intermediation with information asymmetry and monitoring costs (Williamson, 1987; Holmstrom and Tirole, 1997). While previous empirical studies also documented a positive association between bank ties and future credit access (Peterson and Rajan,1994; Bigsten et al., 2003; World Bank, 2015), they did not examine implications on firm-level investment or employment outcomes. To our knowledge this is the first paper to examine the investment effects of financial frictions using the persistence of bank ties in a high growth environment. Like most studies in this literature we also use firm size as an additional proxy for potential credit constraints.[2] Combining these two proxies allows us to detect heterogeneous investment responses even among small firms than would be possible in simple size-based comparisons. [3]

While focusing on sticky bank ties, our empirical model also incorporates the traditional approach to capturing financial frictions that relies on the strength of the investment-cash flow relationship (Fazzari et al.,1988). While plenty of earlier studies suggested that internal funds

[2] See for instance Gelos and Werner (2002), Bigsten et al. (1999), Jaramillo et al. (1996), Athey and Laumas (1994) and Tybout (1983). In developed countries, researchers use dividend retention patterns and utilization of credit rating services to proxy credit constraints in addition to firm size.

[3] A few studies have addressed this issue including Whited (2006), Beck et al. (2005) and Chodorow-Reich (2014).

may impose an upper bound on the investment responses of credit-rationed firms (Hubbard, 1998), recent studies seem to cast serious doubt on this widely accepted notion. Cummins, Hassett, and Oliner (2006) and Cooper and Ejarque (2003) show that accounting for measurement errors in investment opportunities and omitted variables may nearly eliminate the sensitivity of investment to cash-flow even for potentially credit constrained firms.[4] These studies have reignited research interests in the real sector effects of financial market imperfections while underscoring the need for careful measurement in investment opportunities and firm heterogeneity in sensitivity to credit constraints. [5]

Accordingly, we measure firms' investment opportunities by adhering to a recent approach that models investment as an error correction mechanism (Bloom, Bond and Van Reenen, 2007; Hall, Mairesse and Mulkay, 1999). This approach allows us to distinguish short-term investment opportunities from equilibrium capital shortfalls. This distinction is particularly important in understanding the discontinuity and lumpiness of investment decisions, which are highly pronounced among African firms. Accordingly, we estimate not only firms' average investment response but also their transition from a state of investment inaction to that of moderate and/or lumpy investment activities. While previous studies attributed intermittent and

[4] Gomes (2001) also highlights that the investment-cash flow relationship could exist without financing constraints. In transition economies, Guariglia et al. (2012) find that the investment-cash flow relationship is significant only for firms with irreversible investment.

[5] There is also a growing interest in financial market imperfections in the trade literature. Amiti and Weinstein (2011) examine the effect of credit constraints on firm-level exports in Japan, while Berman and Héricourt (2010) use firms' financial positions to proxy credit constraints. At the aggregate level, Manova (2013) uses the sensitivity of industries to credit constraints and the level of advancement of the financial sector across countries to assess comparative advantage in trade. Only in rare cases, as in Minetti and Zhu (2011), do researchers have direct response from firm-level credit rationing.

lumpy investment patterns in Africa to demand uncertainty and irreversibility (Pattilo, 1999; Bigsten et al., 2005; Shiferaw, 2009a), this paper examines for the first time if financial frictions can also help explain these investment patterns. [6]

As a preview of our results, we find widespread and largely persistent credit constraints among privately owned manufacturing firms in Ethiopia even as the economy continues to grow. Econometric estimates suggest that firms without initial bank ties exhibit significantly lower average investment rates and longer durations of investment inaction relative to firms with initial bank ties. Lumpy investment episodes that lead to sizable growth in capital stock are more likely to occur among large firms and those with a history of bank ties. Interestingly, small firms with credit access seem to be at least as responsive to investment opportunities as larger firms. To check the robustness of our results we exploit firm and industry characteristics that are associated with cross-sectional variation in the degree of sensitivity to credit constraints. We look specifically at firms' product scope and intensity of import competition at the industry level that may affect firms' liquidity status. We find that the investment-enhancing role of external finance tends to be stronger among financially vulnerable firms.

The paper is organized as follows. The next section highlights the unique macroeconomic context within which firm-level investment is analyzed. Section three explains the investment models to be estimated and measurement of key variables. Section four introduces the firm-level panel data and provides descriptive statistics while econometric results are presented in

[6] Understanding the discontinuity and lumpiness of firm-level investment is very important given their implications on aggregate investment patterns (Caballero et al.,1995).

section five. Robustness checks are carried out in section six using firms' product scope and import intensity of industries in which they operate as sources of sensitivity to credit constraints. Discussion and conclusions are provided in section seven.

2. Macroeconomic Context

The Ethiopian economy began to recover in the mid 1990s following a series of economic reforms that started in 1991/92 (See Appendix A for details). The recovery gave way to outstanding performance since 2003 with about 10 per cent annual average GDP growth. Ethiopia is also a historically low-inflation country except for a spike in consumer prices during 2008-2009. In addition to removing restrictions on private investment imposed by the previous communist regime, the current government invested heavily on economic infrastructure (Shiferaw et al., 2015). Figure 1 shows that domestic investment increased from about 20 per cent of GDP before the reform to well above 30 per cent since 2002/03. The rise in aggregate investment is driven entirely by a 15 percentage points increase in public investment since the mid 1990s. In the meantime, private investment remained relatively weak and volatile; in fact it declined from 19 per cent of GDP in 2002/03 to about 14 per cent in 2011/12.

The firm-level data that we use in this paper is broadly consistent with this aggregate picture where private investment in manufacturing (as percent of capital stock) declined from 17 per cent in 1997 to about 8 per cent in 2002 before recovering to 16 per cent in 2007. On the other hand, the number of registered manufacturing firms (with at least 10 workers) has more than doubled in 2007 from around 630 firms in 1996. Total manufacturing employment grew by

about 3 per cent per annum during the sample period. This suggests a timid post-entry expansion of firms through investment while there appears to be no shortage of entrepreneurs entering the manufacturing sector at a small scale. It is also worth noticing that the GDP share of manufacturing remains at 5 per cent despite Ethiopia's rapid growth.

Our search for potential investment constraints focuses on developments (lack thereof) in the financial sector. As discussed in detail in Appendix A, a number of recent studies show that the Ethiopian financial sector has a long way to go even by African standards (World Bank 2009, 2015; Zewdu 2014). The sector is heavily dominated by state-owned banks and remains completely closed to foreign financial institutions. Most importantly, outstanding credit to the private sector, a widely used proxy for financial sector development, declined from 19 per cent of GDP in 2003/4 to about 14 per cent in 2011/12, which is far below the African average of 23 per cent of GDP (World Bank, 2015). Following the intensification of public investment activities since the late 1990s, credit from state-owned banks has been channeled primarily to infrastructure projects as well as expansion of state-owned enterprises (Zewdu 2014). Private banks account for less a third of the market and operate under heavy regulations that restrain financial intermediation. The private banks also impose exceptionally high collateral requirements on private borrowers (World Bank, 2015). The contraction in credit supply to the private sector comes as no surprise and closely fits the downward trend in private investment (Figure 1). Tighter credit markets for the private sector essentially reflect government policy priorities in allocation of financial resources rather than lenders' response to changes in real sector business fundamentals. The rest of the paper essentially provides a microeconomic perspective on this aggregate picture by exploiting across-firm variation in access to credit.

3. Investment models and measurement issues

Modeling average investment rate

We model firm-level investment as an error correction mechanism similar to the approach in Bloom, Bond and Van Reenen (2007) and Hall, Mairesse and Mulkay (1999). This approach assumes cointegration of actual and desired stocks of capital implying a stable equilibrium relationship in the long run. This assumption permits a more flexible reduced-form Error Correction Model (ECM) in which the firm adjusts its capital stock both in response to short-term changes in demand as well as to deviations from the long-term equilibrium path. This distinction allows us to capture investment opportunities better than the common practice of using growth in real sales (or value added) as the only proxy. As argued in Bloom et al. (2007), the ECM also provides a reasonable alternative to neoclassical investment models that rely on a quadratic adjustment cost technology, an assumption that is at odds with the discontinuous and lumpy nature of firm-level investment even in developed countries.

Details on the error correction model and the calculation of desired stock of capital are reported in technical Appendix B.

The basic ECM investment model augmented with cash flow (π) and a composite error term can be expressed as:

$$\left(\frac{I_{it}}{K_{i,t-1}}\right) = a + \psi\Delta\log Y_{it} + \phi MI_{i,t-1} + \lambda\pi_{it} + \upsilon_i + e_t + u_{it} \quad (1)$$

where $MI_{i,t-1} = \gamma \log K^*_{i,t-1} - \log K_{i,t-1}$ is the error correction term that we will refer to as *Mandated Investment* (*MI*) hereafter. v_i stands for unobserved firm fixed effects, e_t represents time fixed effects common to all firms, and u_{it} is a time varying random error term. To test for the effects of uncertainty on investment we include volatility in the rate of change of profit $\left(\sigma^{\pi}_{it}\right)$. We also include a non-linear term in mandated investment to assess the investment response to very large capital shortfalls. The investment model we set out to test is thus:

$$\left(\frac{I_{it}}{K_{i,t-1}}\right) = a + \psi\Delta\ln Y_{it} + \phi_1 MI_{i,t-1} + \phi_2 MI^2_{i,t-1} + \lambda\pi_{it} + \varphi\sigma^{\pi}_{it} + e_i + v_t + u_{it} \quad (2)$$

If firms are credit rationed or face high cost of external finance, then their ability to respond to investment opportunities may be restricted by the size of internal funds. According to Fazzari et al. (1988), λ is expected to be positive for firms that are face financing constraints while it should be insignificant for unconstrained firms.

We estimate Eq. (2) using the System Generalized Method of Moments (GMM) suggested by Blundell and Bond (1998). This method eliminates unobserved firm fixed effects that may correlate with explanatory variables through first differencing. Time specific effects such as changes in user cost of capital, shifts in macroeconomic policy and business cycles that may affect investment decisions of all firms will be controlled for by time dummy variables. The

system GMM estimator also uses suitably lagged differences to instrument endogenous variables in the levels equation and lagged levels as instruments for the equation in first differences. Identification of coefficients is based on these instruments being uncorrelated with equation errors. We expect cash flow and growth in sales to be endogenous to investment decisions and we use the second, third and fourth lags of these variables in levels as instruments for the equation in first differences, and all available differences are employed as instruments for the levels equation. Mandated investment captures the lagged gap between desired and actual stocks of capital and enters as a pre-determined variable. While cash flow is endogenous, the standard deviation of its growth rate over a three-year window, which is our proxy for demand uncertainty, is assumed to be a random shock.

Estimating the role of external finance on firm-level investment requires firm specific information on the likelihood of being credit rationed. Our strategy is thus to estimate Eq(2) for subsamples of firms facing different degrees of credit constraints. While firm size is a readily available proxy, it does not capture credit constraints adequately (Fazzari et al. 1988; Whited, 2006). We thus use borrower-lender relationships to detect real sector effects of financial frictions similar to Chodorow-Reich (2014). Previously, Peterson and Rajan (1994) find that ties with financial intermediaries increase the availability of credit for small firms in the United States. In sub-Saharan Africa, Bigsten et al. (2003) show that access to credit actually increases with the size of outstanding debt after controlling for cash flow and firm size. World Bank (2015) also reveals that Ethiopian commercial banks rely heavily on traditional practices of relationship lending rather than credit rating services to screen loan applications. The assumption is that such relationships are sticky and would allow firms to overcome the

information asymmetry problem in the future as compared to otherwise similar firms without bank ties.

Since our data does not measure directly firms' borrowing activities and outstanding debt, we detect them indirectly by observing interest payments. Accordingly, our proxy for bank ties is a dummy variable that takes the value one if interest payments (on a loan or line of credit) occurred during 1996 to 1999 and zero otherwise. The choice of 1996-99 as the initial period reflects the launching in the 1990s of major public investment projects in Ethiopia, such as the Road Sector Development Program (RSDP), that intensified after 2000. Lending to the private sector as per cent of GDP also started to decline in the early 2000s. Using initial rather than contemporaneous bank ties allows us to mitigate against potential simultaneity between formation of bank ties and the decision to invest. The investment models will thus be estimated over the period 2000-2007 conditional on the status of bank ties during 1996-99. As a further safeguard against the possible simultaneity between bank ties and investment decisions, we also explore initial non-loan financial relationships as part of our robustness checks.

Modeling Intermittent and Lumpy Investment

Most of the literature on financing constraints examines the sensitivity of average investment spending to internal funds. Most recently, Whited (2006) examined the effects of financial frictions on the timing of large investment outlays. She finds a lower hazard of investment spikes for credit constrained small firms in the U.S. as compared to that of unconstrained small firms.

This line of inquiry is particularly important for firms in our sample that exhibit discontinuous and lumpy investment patterns (See Table 2). This allows us to assess how financial frictions influence the timing of non-zero and large investment outlays. For better comparison with existing studies, we consider an investment rate in excess of 20per cent as lumpy investment. We use the proportional hazard model proposed by Cox (1972) to estimate shifts in the hazard function.

The idea is to estimate a conditional hazard model $\lambda(t;x)$ which can be expressed as a function of firm characteristics (x):

$$\lambda\left(t;x\right)=\frac{f\left(t\left|x\right.\right)}{1-F\left(t\left|x\right.\right)}=\frac{f\left(t\left|x\right.\right)}{S\left(t\left|x\right.\right)}$$

where $f\left(t\right)$ is the density of time under risk T . Time under risk refers to spells of zero investment in which case the model estimates the likelihood of non-zero investment in the next short period of time having been in a state of investment inaction for a while. For lumpy investment, time under risk refers to a state where investment rates are below 20 per cent and the model estimates the probability of an investment spike in the next short period of time. The proportional hazard model estimates the hazard of a given outcome $\lambda_i\left(t\right)$ for a particular group of firms relative to a non-parametric baseline hazard function $\lambda_0\left(t\right)$ that is common to all

subsamples of firms. The hazard ratio is assumed to take the form $\frac{\lambda_i(t)}{\lambda_0(t)} = \exp(\beta' x_i)$, which can be expressed as:

$$\log \lambda_i(t) = \log \lambda_0(t) + \beta' x_i \qquad (3)$$

The vector x includes investment opportunities as well as cash flow as discussed in Eq.(2). We expect that short-term changes in demand would trigger relatively frequent but modest capital adjustments while systematic shifts in MI would induce relatively rare but lumpy investment outlays. Unlike the System GMM model where the coefficients on proxies for credit access cannot be estimated due to elimination by first differencing, these proxies will be included directly in Eq(3) to estimate their effects on the hazard function.

4. Data and Descriptive Analyses:

We use a unique firm-level panel data obtained from annual census of manufacturing firms conducted by the Central Statistical Agency (CSA) of Ethiopia[7]. The census captures all manufacturing firms that employ at least 10 workers and use power driven machinery. The data provide basic information on production activities including number of workers, purchase of intermediate inputs, indirect production costs, sales and export activities as well as investment on machinery and equipment, and beginning and end of period capital stocks. We

7 The survey is officially referred to as Survey of Large and Medium Scale Manufacturing Industries.

have an unbalanced panel of 1339 firms for the period 1996-2007 of which 69per cent are small firms employing fewer than 50 workers.

Table 2 shows that 67 per cent of firms (54 per cent of firm-year observations) are credit constrained based on our bank ties proxy. This is consistent with the findings of World Bank (2015) in which Ethiopia has the highest percentage of firms (56 per cent) that reported credit constraints as a major problem. While the majority of firms without bank ties are small, as one would expect, a little over half of all firms with bank ties are also comprised of small firms.

Firms with bank ties have nearly twice the average investment rate of credit constrained firms while also being twice as likely to have lumpy investment episodes (IR>20 percent). Interestingly, there are no indications that credit-constrained firms are less profitable[8] or encounter limited investment opportunities, in terms of mandated investment and real sales growth, as compared to firms with bank ties. These patterns obtain if we use firm size to proxy potential financing constraints except that sales growth is faster among large firms.

Figure 2 shows a slightly right-skewed and leptokurtic distribution of mandated investment with about 70 per cent of observations having capital shortages (positive MI) while the remaining 30 per cent exhibit excess capacity. Interestingly, firms with widely different probabilities of accessing external finance exhibit trivial differences in the distribution of investment opportunities as shown in Figure 2. Figure 3 shows a co-movement of mandated and actual investment rates with an upswing since 2002 both for credit constrained and unconstrained

8 Bigsten et al. (1999) report comparable profit rates for manufacturing firms in four other Sub-Saharan African countries showing relatively high rates of return.

firms. Firms without relationships with banks clearly invest at a lower rate than financially connected firms although the former are more profitable on average. However, there is more variation over time in the average investment rate of firms with access to credit relative to credit-constrained ones.

Panel (a) of Figure 4 also shows a relatively subdued responsiveness of credit-rationed firms to investment opportunities as compared to unconstrained firms. Rather than disinvesting, firms with excess capacity (negative MI) seem to allow their capital stock to decline through depreciation as investment rates are just under 10 per cent – which is consistent with irreversibility of most investment decisions. Investment by credit-constrained firms remains mostly under 10 per cent and rises above this threshold only for extremely large investment gaps. Panel (b) of Figure 4 underscores that the hazard of lumpy investment among credit-constrained firms lies far below that of unconstrained firms. Lumpy investment shows a positive-duration dependence in both subsamples of firms suggesting an increase in the likelihood of such investment the longer the time interval since the previous episode of lumpy investment.

These preliminary observations suggest that credit constraints are widespread among Ethiopian firms and such constraints seem to abate the vigor of private investment activities.

Initial bank ties and subsequent borrowing

Before proceeding to estimates of our investment models, it is important to show that initial bank ties indeed play a role in subsequent access to credit. We show this by running a logit regression of access to credit during 2000-07 conditional on initial bank ties as well as average firm size and profit rates during 2000-07. The logit model also controls for industry fixed effects that banks may take into account in evaluating loan applications as well as region fixed effects that capture location specific differences in credit supply, say due to availability of bank branches or regional variation in economic potential. The reported average marginal effects in Table 3 clearly indicate that initial bank ties have a significant association with access to credit after controlling for relevant firm characteristics. As would be expected firm size raises the likelihood of bank credit up to a certain threshold while profit rates have a smaller but statistically significant negative coefficient.

Caution should also be exercised in interpreting our results given inherent weaknesses in our proxies. It is quite possible that some of the firms identified as credit constrained by our proxies may not have financing problems to begin with and did not apply for loans. For instance, Bigsten et al. (2003) report that about half of the firms in their sample did not apply for credit. Similarly, firms with bank ties may experience credit constraints if banks decide to partially approve loan applications. While these are important drawbacks of our proxies due to data limitations, they actually work against our hypothesis of finding a significant difference in investment behavior between the two groups of firms. In other words, if some of the firms identified as credit-constrained by our proxies have zero credit demand to begin with, this should not affect their investment responses. Similarly, if banks approve a fraction of the requested loan, this will undermine firms' investment responses although our proxies identify

them as unconstrained. Systematic differences between credit-constrained and unconstrained firms in our sample on the basis of bank ties are thus more likely to be lower-bound estimates.

5. Discussion of Econometric Results

Average investment rate

Table 4 reports system GMM estimates of the investment model in Eq. (2). The first three columns refer to results using contemporaneous status of bank ties while the last three columns refer to initial bank ties. For the latter, the regression analysis is restricted to the period 2000-2007 for firms whose initial bank ties can be observed in 1996-99. The identification of coefficients appears to be satisfactory as indicated by the Hansen test for overidentification as well as the Arellano-Bond test for second order autocorrelation of equation errors. There is some concern with estimates for the entire sample in the first column where the Hansen test suggest correlation of instruments with the error term.

It is clear from Table 4 that firms with bank ties have stronger investment responses to investment opportunities (MI) relative to firms without bank ties. This general observation holds whether we use contemporaneous or initial relationships with banks although the latter allows us to address potential simultaneity between investment and bank ties. The coefficients on MI and MI-squared are both positive and significant only for firms with bank ties while only the linear term is significant for the other group. The elasticity of investment with respect to MI

for firms with initial bank ties (0.0198) is 45 per cent larger than that of firms without initial bank ties. This suggests that firm-level investment activities tend to be stronger with better access to external finance. Unlike most previous studies, however, we do not find a significant investment-cash flow sensitivity in any group including firms with relatively high information asymmetry problem. Regardless of bank ties, short-term changes in real sales do not have significant association with average investment rate. This suggests that managers pay more attention to systematic deviations of actual capital stock from a desired level in making investment decisions.

Table 5 uses firm size to proxy potential credit constraints. In the first two columns we split the sample during 2000-07 based on initial firm size during 1996-99. As would be expected, large firms are more responsive than small firms for a given investment opportunity; the elasticity of investment to MI is about 50 per cent higher among large firms. To further examine the importance of access to credit for small firms, we compared small firms with and without bank ties. However, the number of small firms during 2000-07 whose initial bank ties (1996-99) can be identified is too small because of high exit rates among small firms and a lower percentage of small firms with initial bank ties. We thus used contemporaneous firm size and bank ties during 1996-2007 to re-estimate the investment model. This can potentially be problematic although Table 4 suggests that using initial or contemporaneous bank ties makes very little difference. Similar comparison among large firms with and without bank ties is less informative as large firms typically have well established bank relationships.[9] Results in Table 5 pass the

[9] This also implies few observations of large firms without bank ties for the GMM model.

overidentification test except for small firms without bank ties. This might have to do with the essentially flat gradient of mean investment with respect to investment opportunities among credit-constrained firms, which is particularly the case among credit-constrained small firms.

Columns 3 and 4 of Table 5 show that investment by large firms increases with MI at an increasing rate although the coefficient on the linear term is weakly significant at 13 per cent. In contrast, only the linear term of MI is statistically significant among small firms. This difference is qualitatively similar to the results in columns 1 and 2 of Table 5 although the responsiveness of investment by large firms is now 29 per cent higher than that of small firms as compared to the 50 per cent difference when initial size is used for the sample split. Most importantly, small firms with bank ties are much more responsive to investment opportunities than the average small firm or even the average large firm. Specifically, Table 5 shows that the elasticity of investment with respect to MI among small firms with access to credit is more than three times that of the average small firm and 85 per cent higher than that of large firms.

The problem with the identification of coefficients in the last column of Table 5 notwithstanding, small firms without access to credit have a lackluster investment response as compared to small firms with bank connections. Our results therefore seem to suggest a rank ordering of investment responses to exogenous shocks in opportunities where small firms with(without) access to credit are the most(least) responsive with large firms standing in between. As in Table 4, Table 5 also shows no systematic investment-cash flow relationship even for credit-constrained firms.

Hazard model estimates

We now turn to estimated hazards of non-zero and lumpy investment episodes. Unlike the GMM estimator where time-invariant covariates are eliminated from the model, the hazard models allow us to include directly both bank ties and firm size as proxies for credit constraints. Results are reported in Table 6. The first two columns use initial bank ties and initial firm size while the last two columns use contemporaneous values of both proxies. The global test for proportionality of the hazard function suggests that this assumption has not been violated. This assumption also holds for each covariate individually although these tests are not reported here. All standard errors are clustered at the firm level.

Table 6 reveals a number of interesting investment patterns. While lumpy investment episodes are strongly responsive to shocks in mandated investment, the latter do not shift the hazard of non-zero investment significantly. This sounds intuitive considering that most investment outlays relate to modest adjustments of capital stock during mundane repair and maintenance rather than substantial changes in production capacity. Put differently, our results suggest that major investment outlays often occur when the gap between desired and actual stocks of capital grows wider. Consistent with this observation, non-zero investment episodes are significantly associated with short-term growth in sales, while the latter do not seem to drive investment spikes. The observation that investment spikes are triggered by large investment gaps while changes in current sales call for modest investment through routine maintenance and repair holds whether we use initial or contemporaneous proxies for credit constraints.

Table 6 also shows that firm size, both initial and contemporaneous, has a significant positive association with the incidence of non-zero as well as lumpy investment. The firm size effect seems particularly stronger on the incidence of non-zero investment. Most importantly, Table 6 shows that having a relationship with banks significantly shifts the hazards of both lumpy and non-zero investment episodes after controlling for firm size. The coefficient on initial bank ties in the model for lumpy investment is not significant at conventional levels of significance but it appears to be sufficiently close given the rare occurrence of lumpy investment episodes. These findings suggest that relationships with financial intermediaries may help overcome the information asymmetry problem beyond the benefits of being a large firm. Small firms might thus be able to challenge the market share of entrenched large firms if they can overcome credit barriers. Table 6 also reveals that using contemporaneous bank ties may overestimate its association with investment decisions. Similar to the results in Tables 4 and 5, cash flow has no significant association with the timing of lumpy or non-zero investment outlays.

6. Robustness Checks

Alternative proxy for credit constraints

If relationships with banks allow firms to overcome the information asymmetry problem, then it should not be restricted to previous acquisitions of loans. In this section we provide additional evidence by using initial non-loan financial relationships with lenders to proxy potential credit constraints. This proxy is based on bank charges for using financial services other than a loan

or a line of credit. These include fees for processing letters of credit (LC), payroll and pension payments on behalf of the firm, foreign transaction fees, etc. The idea is that such relationships may allow firms to gradually overcome the information asymmetry problem and acquire credit. We create a dummy variable for initial non-loan bank ties (NLBT) that takes the value one if payments for non-loan financial services occurred during 1996-99 and zero other wise. Accordingly, about 43 per cent of firms (65 per cent of observations) have non-loan bank ties, which is higher than the fraction of firms with loan based bank ties. As shown in Table 2, this variable has a positive and significant association with access to credit during 2000-07. The rest of this section examines investment behavior during 2000-07 for sub-samples of firms with and without initial NLBT. The results are presented in Table 7 for the average investment rate and in Table 8 for the timing of lumpy and non-zero investment episodes.

Columns 1-3 of Table 7 report the results for the entire sample and for firms with and without initial bank relationships, respectively. Firms with initial NLBT are nearly twice as responsive to investment opportunities as firms without NLBT, which is consistent with Table 4. Columns 4-6 of Table 7 provide comparison among small firms. Unlike Table 5 we now have enough number of observations on small firms in the 2000-07 sample whose initial NLBT status can be tracked. Table 7 shows that initially small firms with non-loan bank ties during 1996-99 are 47 per cent more responsiveness to investment opportunities than initially small firm without NLBT. Since large firms typically have NLBT, a similar comparison within this subgroup is not relevant. Based on coefficients for large firms in the first column of Table 5, it is clear from Table 7 that initially small firms with NLBT are as responsive to mandated investment as their large counterparts.

Table 8 provides estimates of the hazard model for investment spikes as well as non-zero investment episodes using NLBT. The first two columns use initial firm size and NLBT while the last two columns use contemporaneous size and bank ties. Firms with initial non-loan bank ties are not only more likely to invest but also more likely to have investment spikes. These results obtain when contemporaneous NLBT are used instead. Interestingly, the shift in the hazard of lumpy investment with respect to initial NLBT is larger and more precisely estimated than the coefficient on initial firm size. Similar to the results in Table 6, investment spikes are more responsive to mandated investment while non-zero investment episodes are strongly correlated with current growth in sales.

Firm and Industry Characteristics

To further test the robustness of our findings, we consider cross-sectional variation in sensitivity to credit constraints based on firm and industry characteristics that, according to the relevant literature, may influence firms' financial positions. At the firm level, we consider product scope to assess vulnerability to credit constraints. Recent studies suggest that multi-product firms are larger, more efficient and export oriented than single-product firms (Bernard et al., 2010; Goldberg et al., 2010). Most importantly, the intra-firm reallocation of resources across products may increase not only the average productivity of multi-product firms (MPF) but also their resilience against adverse business shocks given their diversified revenue streams. Single-product firms (SPF), however, are more likely to face liquidity constraints

relative to MPF. Therefore, we expect investment by SPF to be more sensitivity to credit constraints in comparison with MPF.

Using CSA's firm-level data we identified 138 five-digit products in Ethiopian manufacturing within 41 four-digit ISIC industries. This allows us to identify single- and multi-product firms and split our sample accordingly to re-estimate the investment models. As shown in Table C1 in the Appendix, MPF account for 34 per cent of observations and 42 per cent of total manufacturing sales in our sample. While large firms account for about 30 per cent of observations, they account for 37 per cent of MPF - showing an overrepresentation of large firms among MPF.

At the industry level, we consider variation in the degree of import competition to capture vulnerability to lack of external finance. Recent trade theories suggest that import competition may reduce the market share of domestic firms and/or force them to reduce their markups (Melitz and Ottaviano, 2008). This is because of direct competition with high productivity firms from abroad that self-selected into exporting (Melitz, 2003). Access to credit may thus be much more important for investment in import competing industries as compared to relatively protected ones. Using highly disaggregated trade data on imports from the Ethiopian Custom's Authority (ECA) we calculated import penetration rates for industries at the four-digit ISIC level. [10] Industries with import penetration rates above the mean of the entire manufacturing sector are considered to be facing high import competition (HIC) while the rest are considered to encounter low import competition (LIC). According to this criterion, the Food

[10] Import penetration rates are calculated by dividing total imports by the sum of imports and domestic output minus exports.

and Beverage, Leather and Footwear, and Non-metal industries have low competition from imports while the Textile and Garments, Printing and Paper, Chemical and Plastic, and Metal and Machinery industries face high import competition.

System GMM estimates of Eq.(2) are provided in Tables 9 where subsamples of firms are identified on the basis of their product range and import competition. Since mandated investment (MI) is the only variable that turns out to be statistically significant in previous system GMM estimations, for the sake of brevity Table 9 reports only the elasticity of investment with respect to MI taking into account the coefficients on the linear and squared terms of MI.[11] Tables 10 and 11 provides hazard model estimates for the timing of lumpy and non-zero investment empisodes, respectively.

According to Table 9, there is negligible difference between the average single- and multi-product firms regarding the investment response to MI. However, SPF with access to credit appear to be much more responsive to MI as compared to SPF without access to credit. We observe a three-fold gap in responsiveness to MI among SPF if we use non-loan bank ties and a five-fold difference if we used loan-based bank ties. On the other hand, MPF with and without access to credit show practically no difference in their responses to investment opportunities regardless of the type of proxy for credit rationing. This suggests that financing constraints are much more binding for SPF in comparison with firms that rely on a diversified product basket. It is also interesting to note that SPF without access to credit are nearly half as

[11] The full set of results can be made available from the author upon request.

responsive to investment opportunities as MPF without access to credit, while SPFs with access to credit are nearly twice as responsive to MI as MPF with access to credit.

The lower half of Table 9 shows that, other things being equal, the elasticity of investment in HIC industries with respect to MI is substantially larger (nearly twice) than that of LIC industries. While access to credit is associated with increased responsiveness to investment opportunities in both HIC and LIC industries, the shift in elasticity is much more pronounced for HIC firms when we consider non-loan bank ties. While HIC and LIC firms without non-loan bank ties are equally weakly responsive to MI, HIC firms with non-loan bank ties are more than three-times responsive to MI than LIC firms with similar bank ties.

Our findings in Tables 9 suggest that for a given shock in investment opportunities, better access to credit seems to increase the investment activities of firms that are more likely to be liquidity constrained either because of reliance on a single product or due to competition from imports.

In Tables 10 and 11 we use firms' product range and exposure to import competition to assess the relative importance of access to credit for lumpy and non-zero investment episodes, respectively. Table 10 shows that exogenous shocks in investment opportunities are more likely to induce lumpy investment in multi-product firms relative to single-product firms. However, bank ties shift the hazard of lumpy investment significantly for SPF while the coefficient is insignificant for lumpy investment by MPF. This is also true in reference to firm size, which shifts the hazard of lumpy investment among SPF but not among MPF. The last

two columns of Table 10 compare firms with high and low import competition. Here too, the coefficient on bank ties is larger and highly significant for HIC firms while it is weakly significant (at 13 per cent) for LIC firms as initially expected. Overall, Table 10 shows that access to credit tends to speedup the transition from weak to vigorous investment activities for firms that are more likely to face liquidity constraints based on our proxies. No such association is evident for firms that are less likely to be liquidity constrained.

This exercise is repeated in Table 11 for the hazard of non-zero investment. While being a large firm shortness the duration of investment inaction significantly regardless of being an SPF or MPF, having ties with financial intermediaries has a positive effect only for SPF. The shift in the hazard of non-zero investment associated with having a relationship with banks is also stronger for HIC firms although the coefficient is statistically significant regardless of the intensity of import competition.

Table 11 also reveals that the timing of non-zero investment episodes is closely associated with the deviation of actual capital stock from the desired level among MPF while it is primarily associated with short-term changes in sales for SPF. External financing constraints are thus less binding for investment decisions of firms that are a priori less likely to be liquidity constrained either because they have diversified streams of revenue or because they encounter less competition from imports.

7. Conclusions

It is evident that large and sustained public investment in infrastructure has facilitated rapid economic growth in Ethiopia over the last two decades (World Bank, 2009; 2015; Moller and Wacker, 2015). At the micro-level, Shiferaw et al. (2015) show that Ethiopian towns with better road connectivity attract more and relatively larger new manufacturing firms. Given the large infrastructure gap in African countries, this development is undoubtedly desirable. However, the depth of financial market imperfections in Ethiopia coupled with a dramatic increase in government borrowing to fund ambitious public investment programs appear to have undermined the ability of private entrepreneurs to take advantage of improved infrastructural services. The crowding-out effect apparently works through the credit channel as evidenced by the decline in the fraction of outstanding credit to the private sector.

The microeconomic evidence we provide in this paper is consistent with the above-mentioned aggregate indicators of private investment. Private manufacturing firms undertake lackluster investment activities that barely offset the effects of depreciation. While investment opportunities seem to abound across all firms, the distribution of actual investment is highly skewed in favor firms with initial bank ties, which account for about a third of the manufacturers. We find that small firms with access to credit are at least as responsive to investment opportunities as large firms are, leaving credit-constrained small firms at the bottom of the investment distribution. Ceteris paribus, firms with access to credit also have a relatively shorter duration of investment inaction and better chances of lumpy investment episodes as compared to credit-constrained firms. Our finding also underscore that bank ties are relatively

more important for firms that are more likely to be liquidity constrained either because they rely on a single product line or face intense competition from imports.

The challenge for policymakers is to manage the pace of infrastructure development programs while also relaxing the regulatory burden on financial intermediaries such that the private sector can take advantage of improvements in public infrastructure. Interestingly, the restrictive financial regulations on private banks have reduced the size of loanable funds for long-term investment projects, which in turn forces private banks to limit their lending activities primarily with well-established clients (World Bank, 2015).

Credit-constrained firms in our sample do not show a strong investment-cash flow relationship that earlier studies from developing countries documented. Our findings seem to be consistent with recent studies that find no support to the investment-cash flow sensitivity once better proxies for investment opportunities are used. Before tax gross profit rates are very high in Ethiopian manufacturing regardless of firm size and relationships with banks. The average profit rate remained quite stable over the sample period while mandated investment, real sales and the number of firms grew rapidly between 2002-2007. One possible explanation for the lack of strong investment-cash flow sensitivity is the tendency for private entrepreneurs to use profits to start new small firm instead of reinvesting it in the same firm (Shiferaw, 2009).

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Table 1: Firms with Zero Investment and No Access to Credit (%)

	Number of Firms	Zero Investment Spending (%)	No bank loan or line of credit (%)	Zero Investment Spending		GDP Growth Rate (2005-14)
				No Access to Credit	Access to Credit	
1	2	3	4	5	6	7
Burkina Faso (2006)	394	50.8	69.0	57.4	37.5	6.0
Burundi (2006)	102	49.0	59.8	59.0	34.2	4.1
Burundi (2014)	157	59.9	37.6	72.9	51.5	
Cameroon (2009)	363	52.9	65.0	60.6	38.4	3.7
Kenya (2007)	657	40.6	58.6	50.1	27.2	5.3
Kenya (2013)	781	51.7	57.9	59.5	39.7	
Ghana (2007)	494	49.2	81.4	55.0	24.0	7.3
Ghana (2013)	720	48.1	77.2	51.6	36.0	
Malawi (2009)	150	33.3	59.3	41.6	20.0	5.5
Malawi (2014)	523	58.3	69.2	64.9	40.0	
Rwanda (2006)	212	38.7	65.1	38.4	39.2	7.7
Rwanda (2011)	241	51.5	49.0	58.5	44.3	
Zambia (2007)	484	61.0	n.a.	n.a		7.7
Zambia (2013)	720	57.4	84.4	60.7	36.3	

Source: World Bank Enterprise Survey.

Table 2: Summary Statistics

	All Firms	Bank Ties		Firm Size	
		No	Yes	Small	Large
Investment Rate (IR)	0.114	0.076	0.136	0.093	0.164
Percent of firms with zero investment (IR=0)	0.496	0.684	0.381	0.629	0.245
Percent of firms with lumpy investment (IR>20per cent)	0.161	0.103	0.197	0.112	0.238
Mandated Investment (MI)	2.059	2.489	1.798	1.939	1.691
Real Sales Growth $(\Delta \log Y)$	0.030	0.025	0.034	0.040	0.072
Cash Flow (π)	1.010	1.289	0.835	1.420	0.952
Cash-flow volatility $(\sigma^{\Delta\pi})$	0.370	0.378	0.366	0.384	0.367
Firm Size (No. of workers)	105.338	33.220	163.320	20.217	294.831
Number of Firms*	2697	1704	993	2015	449
Percent of Observations (Firm-years)	10420	0.458	0.542	0.690	0.310
Percent of Small Firms	0.690	0.897	0.524		
Percent Without Bank Ties				0.580	0.149

Source: Central Statistical Agency (CSA) of Ethiopia, 1996-2007.

Note: Because of missing values on number of workers, the number of firms by size category is less than the total number of firms.

Table 3: Access to Credit and Initial Bank Ties : Logit model average marginal effects

	1	2
Bank Ties $_{(1996\text{-}99)}$	0.4619	
	(0.0643)***	
Non-loan Bank Ties $_{(1996\text{-}99)}$		0.1383
		(0.0481)***
ln(employment) $_{(2000\text{-}07)}$	0.3056	0.3650
	(0.1119)***	(0.1195)***
$[\ln(\text{employment})]^2$ $_{2000\text{-}07}$	-0.0267	-0.0320
	(0.0146)*	(0.0156)**
Profit Rate $_{(2000\text{-}07)}$	-0.0236	-0.0284
	(0.0093)**	(0.0091)***
N	622	622

Note: The dependent variable takes the value 1 if a firm has access to credit during 2000-07 and zero otherwise. Bank ties indicate relationships formed during 1996-99. Firm size, labor productivity and profitability are averages values during 2000-07. All regressions include industry and region dummies to control for unobserved industry and location fixed effects. Robust standard errors indicated in parenthesis.

Table 4: Average Investment and Relationship with Bank: System GMM Estimates.

Dependent Variable is Investment Rate $\left(\frac{I_{it}}{0.5*\left(K_{i,t-1}+K_{i,t-2}\right)} \right)$

	Current Bank Ties (1996-2007)			Initial Bank Ties (1996-99)		
	All Firms	Yes	No	All Firms	Yes	No
$MI_{i,t-1}$	0.0134***	0.0221***	0.0073**a**	0.0144***	0.0148***	0.0138***
	(0.0028)	(0.0082)	(0.0050)	(.0033)	(0.0046)	(0.0035)
$MI_{i,t-1}^2$	0.0005	0.0023**	0.0007	0.0004	0.0050***	-0.0002
	(0.0012)	(0.0010)	(0.0009)	(0.0012)	(0.0017)	(0.0011)
$\Delta \log Y_{it}$	0.0015	0.0413	0.0040	0.0034	-0.0020	-0.0043
	(0.0227)	(0.0502)	(0.0383)	(0.0232)	(0.0393)	(0.0376)
π_{it}	0.0048	0.0127	-0.0017	0.0032	-0.0343***	0.0089
	(0.0121)	(0.0230)	(0.0039)	(0.0145)	(0.0048)	(0.0129)
$\sigma_{it}^{\Delta\pi}$	0.0061	0.0011	0.0197	0.0052	-0.0034	0.0087
	(0.0153)	(0.0176)	(0.0333)	(0.0169)	(0.0245)	(0.0282)
Observations	2,506	1,564	942	2123	771	1,352
No. of Firms	657	374	283	569	166	430
No. of instruments	79	79	79	74	74	74
Hansen Test p-value	0.0740	0.9250	0.1890	0.1450	0.4750	0.1370
M1 p-value	0.0000	0.0000	0.0040	0.0000	0.0010	0.0000
M2 p-value	0.1690	0.4610	0.1720	0.1840	0.1690	0.1120

Note: subscripts *i* and *t* index firms and years, respectively. $MI_{i,t-1}$ is lagged mandated investment, $\Delta \log Y_{it}$ is growth in real sales, π_{it} is gross profit rate before tax and $\sigma_{it}^{\Delta\pi}$ is volatility of growth in gross profit rate. The numbers in parenthesis are standard errors clustered at the firm level. *, **, and *** indicate statistical significance at the 10per cent, 5per cent and 1per cent level, respectively, while "a"- indicates significant at 15per cent. Year dummies and a constant term are included in all specifications. Instruments for the equation in first differences include $\Delta \log Y$ and π lagged by 2, 3 and 4 periods, as well as year dummies, $MI_{i,t-1}$, $MI_{i,t-1}^2$ and $\sigma_{it}^{\Delta\pi}$. The instruments for the equation in levels include first differences of $\Delta \log Y$ and π lagged by one period as well as year dummies, $MI_{i,t-1}$, $MI_{i,t-1}^2$ and $\sigma_{it}^{\Delta\pi}$. Hansen-test p-value shows the validity of the overidentifying restriction, while p-values for M1 and M2 check first and second order serial correlation in the first differenced error term.

Table 5: Average Investment and Firm Size: GMM Estimates

Dependent Variable is Investment Rate $\left(\frac{I_{it}}{0.5*\left(K_{i,t-1}+K_{i,t-2}\right)}\right)$

	Initial Firm Size (1996-99)		Current Firm Size and Bank Ties During 1996-2007			
				Small Firms		
	Large Firms	Small Firms	Large Firms	All	With Bank Ties	No Bank Ties
$MI_{i,t-1}$	0.0144**a**	0.0111**	0.0126**a**	0.0128***	0.0288*	0.0080**
	(0.0090)	(0.0043)	(0.0082)	(0.0039)	(0.0155)	(0.0033)
$MI_{i,t-1}^2$	0.0025**	0.0000	0.0037*	-0.0001	0.0013	0.0003
	(0.0011)	(0.0011)	(0.0022)	(0.0007)	(0.0014)	(0.0008)
$\Delta \log Y_{it}$	-0.0276	-0.0172	-0.1086*	0.0397	0.0786	0.0089
	(0.0508)	(0.0244)	(0.0612)	(0.0291)	(0.0679)	(0.0341)
π_{it}	-0.0298***	0.0002	0.0009	0.0018	0.0160	-0.0022
	(0.0080)	(0.0068)	(0.0085)	(0.0052)	(0.0261)	(0.0042)
σ_{it}^{π}	0.0034	0.0153	0.0427	0.0126	0.0156	0.0200
	(0.0307)	(0.0201)	(0.0299)	(0.0252)	(0.0239)	(0.0430)
Observations	434	845	751	1,685	896	789
No. of Firms	100	212	171	460	218	242
Hansen Test p-value	0.6280	0.8920	0.6580	0.2940	0.3580	0.0130
M1 p-value	0.0170	0.0000	0.0010	0.0000	0.0020	0.0100
M2 p-value	0.4990	0.2060	0.1820	0.1430	0.1760	0.2070

Note: See Table 4 for notes. "a" "b" indicate statistical significance at 11 per cent and 14 per cent, respectively. Firm size is a dummy variable that takes the value 1 if the

firm employs at least 50 workers and zero otherwise.

Table 6: Bank Ties and the Hazard of Lumpy and Non-zero Investment (2000-2007)

	Initial Size and Bank Ties (1996-99)		Current Size and Bank Ties (2000-07)	
	Lumpy Investment	Non-zero Investment	Lumpy Investment	Non-zero Investment
$MI_{i,t-1}$	0.1256**	0.0157	0.1180***	-0.0189
	(0.0622)	(0.0377)	(0.0441)	(0.0288)
$MI^2_{i,t-1}$	-0.0050	-0.0097	-0.0039	-0.0028
	(0.0066)	(0.0088)	(0.0044)	(0.0043)
$\Delta \log Y_{it}$	0.1024	0.1903***	0.0852	0.2189***
	(0.1014)	(0.0694)	(0.0852)	(0.0626)
π_{it}	-0.0212	-0.0198	-0.0207**	-0.0237*
	(0.0153)	(0.0180)	(0.0104)	(0.0123)
σ^{π}_{it}	0.3430*	0.1678	0.3133**	0.1056
	(0.1849)	(0.1485)	(0.1579)	(0.1327)
$(Bank-Ties)_i$	0.2874**a**	0.4837***	0.6207***	0.5805***
	(0.1918)	(0.1365)	(0.1729)	(0.1292)
$(Firm-Size)_i$	0.3916**	0.6031***	0.4874***	0.5953***
	(0.1980)	(0.1603)	(0.1504)	(0.1179)
Observations	1,100	618	1575	902
No. of Firms	308	260	530	413
No. of Failures	113	179	178	217
Proportional Hazard p-value	0.1433	0.5821	0.6120	0.9963

Note: The dependent variable in Columns (1) and (2) is a dummy variable that takes the value 1 if the investment rate is greater than 20per cent and zero otherwise, while for Columns (3) and (4) it is a dummy variable that takes the value 1 if the investment rate is nonzero, and zero otherwise. Subscripts

i and *t* index firms and years, respectively. MI_{it} is mandated investment, $\Delta \log Y_{it}$ is growth in real sales, π_{it} is gross profit rate before tax and $\sigma_{it}^{\Delta\pi}$ is volatility of growth in gross profit rate. The numbers in parenthesis are standard errors that are clustered at the firm level. *, **, and *** indicate statistical significance at the 10 per cent, 5 per cent and 1per cent level, respectively, while "a" indicates significant at 14 per cent. Bank-Ties is a dummy variable that takes the value 1 for firms that have paid interest on bank loans or a line of credit at any point in the sampling period and takes the value zero otherwise. Firm size equals one for large firms that employ at least 50 workers and zero otherwise. The p-value for the proportional hazard model provides a global test for the violation of the proportionality assumption.

Table 7: GMM Estimates of Average Investment Based on Initial Nonloan Bank Ties: 2000-07

	All Firms			Small Firms		
	All	With Bank Ties	No Bank Ties	All	With Bank Ties	No Bank Ties
$MI_{i,t-1}$	0.0140***	0.0235***	0.0124***	0.0111**	0.0176**	0.0113*
	(0.0035)	(0.0078)	(0.0042)	(0.0043)	(0.0085)	(0.0058)
$MI_{i,t-1}^2$	-0.0003	0.0009	-0.0001	0.0000	-0.0008	0.0001
	(0.0010)	(0.0016)	(0.0009)	(0.0011)	(0.0009)	(0.0015)
$\Delta \log Y_{it}$	-0.0011	0.0158	0.0045	-0.0172	0.0213	-0.0369
	(0.0281)	(0.0646)	(0.0397)	(0.0244)	(0.0320)	(0.0489)
π_{it}	0.0065	-0.0096	0.0084	0.0002	-0.0013	0.0008
	(0.0101)	(0.0073)	(0.0100)	(0.0068)	(0.0018)	(0.0050)
$\sigma_{it}^{\Delta\pi}$	-0.0037	0.0240	-0.0073	0.0153	0.0310**a**	0.0134
	(0.0206)	(0.0204)	(0.0326)	(0.0201)	(0.0195)	(0.0395)
Observations	1913	749	1164	845	359	486
No. of Firms	577	171	406		80	132
Hansen Test P-value	0.1660	0.1810	0.8140		0.6170	0.1460
M1 P-value	0.0000	0.0000	0.0010		0.0000	0.0120
M2 P-value	0.1750	0.2480	0.0990		0.3270	0.1280

Note: See Table 4 for notes. "a", "b" and "c" indicate statistical significant at 12 per cent, 13 per cent, and 15 per cent, respectively. Please refer to Tables 2, 3, 5 and6 for results pertaining to all firms, small firms, SPF, MPF, HIC and LIC firms. This table only compares firms with and without nonloan bank ties.

Table 8: Hazard of Lumpy and Non-zero Investment Using Non-loan Bank Ties (2000-07)

	Initial Size and Bank Ties (1996-99)		Current Size and Bank Ties (2000-07)	
	Lumpy Investment	Non-zero Investment	Lumpy Investment	Non-zero Investment
MI_{it}	0.1208*	0.0069	0.1135**	-0.0235
	(0.0634)	(0.0378)	(0.0448)	(0.0284)
MI_{it}^2	-0.0051	-0.0095	-0.0043	-0.0026
	(0.0065)	(0.0085)	(0.0044)	(0.0041)
$\Delta \log Y_{it}$	0.0978	0.1880***	0.0810	0.2058***
	(0.1009)	(0.0706)	(0.0844)	(0.0635)
π_{it}	-0.0216	-0.0161	-0.0219**	-0.0252**
	(0.0147)	(0.0174)	(0.0110)	(0.0121)
$\sigma_{it}^{\Delta\pi}$	0.3455*	0.1891	0.3446**	0.1297
	(0.1777)	(0.1495)	(0.1563)	(0.1373)
$\left(\text{Nonloan Bank-Ties}\right)_i$	0.4223**	0.3318**	0.5268**	0.5758***
	(0.2049)	(0.1520)	(0.2130)	(0.1541)
$\left(Firm-Size\right)_i$	0.2841	0.5847***	0.5175***	0.5691***
	(0.2106)	(0.1772)	(0.1457)	(0.1197)
Observations	1,100	618	1,575	902
No. of Firms	309	260	530	413
No. of Failures	113	179	178	247
Proportional Hazard Test, p-value	0.1150	0.4093	0.4887	0.9562

Note: See Table 6 for notes

Table 9: Elasticity of Actual Investment with Respect to Mandated Investment: GMM Estimates

		Bank Credit History		Non-loan Bank Ties	
	All Firms	No	Yes	No	Yes
Multi-product Firms	0.0158***	0.0129**	0.0128[a]	0.0124**	0.0142*
	(0.0053)	(0.0066)	(0.0086)	(0.0063)	(0.0076)
Single-Product Firms	0.0144***	0.0065*	0.0347**	0.0078[b]	0.0242***
	(0.0029)	(0.0038)	(0.0168)	(0.0054)	(0.0071)
Low Import Competition	0.0110***	0.0081**	0.0153***	0.0090**	0.0121**
	(0.0032)	(0.0037)	(0.0057)	(0.0045)	(0.0059)
High Import Competition	0.0284***	0.0158**	0.0275***	0.0089[a]	0.0377***
	(0.0078)	(0.0061)	(0.0089)	(0.0057)	(0.0124)

Note: ***, **, * stand for statistical significance at 1 per cent, 5 per cent and 10 per cent respectively. Letters a and b represent statistical significance at 13 per cent and 16 per cent, respectively. Robust standard errors in parenthesis.

Table 10: The Hazard of Lumpy Investment by Number of Products and Import Competition

	All	SPF	MPF	HIC	LIC
$MI_{i,t-1}$	0.1501***	0.1167***	0.2124**	0.2008***	0.1283***
	(0.0351)	(0.0419)	(0.0893)	(0.0691)	(0.0436)
$MI^2_{i,t-1}$	-0.0077**	-0.0061a	-0.0214**	-0.0157*	-0.0055
	(0.0039)	(0.0039)	(0.0101)	(0.0089)	(0.0042)
$\Delta \log Y_{it}$	0.0205	0.0485	0.0507	-0.0810	0.1034
	(0.0584)	(0.0856)	(0.1065)	(0.0862)	(0.0777)
π_{it}	-0.0080	0.0001	-0.0125	-0.0049	-0.0092
	(0.0123)	(0.0156)	(0.0215)	(0.0192)	(0.0155)
σ^{π}_{it}	0.3389**	0.3322*	0.6072***	0.1702	0.4175**
	(0.1438)	(0.1941)	(0.2278)	(0.2381)	(0.1779)
$\left(Bank-Ties\right)_i$	0.4291***	0.4786***	0.1493	1.0021***	0.2575b
	(0.1468)	(0.1710)	(0.2356)	(0.3364)	(0.1662)
$\left(Firm-Size\right)_i$	0.4791***	0.6833***	0.3924c	0.2900b	0.6104***
	(0.1256)	(0.1507)	(0.2776)	(0.1881)	(0.1650)
Observations	2,566	1,603	780	848	1,668
No. of Firms	650	479	285	218	417
No. of Failures	366	211	123	135	227
Proportional Hazard Test p-value	0.3153	0.9252	0.7283	0.6004	0.5519

Note: see Table 4 for notes. "a" "b" and "c" indicate statistical significance at 12 per cent, 13 per cent, and 16 per cent, respectively

Table 11: The Hazard of Non-zero Investment by Number of Products and Import Competition

	All	SPF	MPF	HIC	LIC
$MI_{i,t-1}$	0.0288*	0.0103	0.0606*	0.0940***	0.0037
	(0.0160)	(0.0192)	(0.0333)	(0.0273)	(0.0199)
$MI^2_{i,t-1}$	-0.0091***	-0.0074**	-0.0196***	-0.0228***	-0.0055*
	(0.0033)	(0.0035)	(0.0062)	(0.0061)	(0.0032)
$\Delta \log Y_{it}$	0.0463*	0.0773**	0.0323	0.0301	0.0469
	(0.0248)	(0.0347)	(0.0465)	(0.0357)	(0.0355)
π_{it}	-0.0104	-0.0055	-0.0143	-0.0095	-0.0089
	(0.0110)	(0.0130)	(0.0183)	(0.0175)	(0.0130)
σ^{π}_{it}	0.1137**	0.1634**	0.2003**	0.1780**	0.0795
	(0.0535)	(0.0650)	(0.0990)	(0.0742)	(0.0757)
$(Bank-Ties)_i$	0.3921***	0.5060***	0.1104	0.5493***	0.3294***
	(0.0867)	(0.1059)	(0.1263)	(0.1610)	(0.1011)
$(Firm-Size)_i$	0.5581***	0.6670***	0.5987***	0.5570***	0.5595***
	(0.0670)	(0.0801)	(0.1132)	(0.0969)	(0.0935)
Observations	2,566	1,603	780	848	1,668
No. of Firms	650	479	285	218	417
No. of Failures	1179	734	372	452	711
Proportional Hazard Test, p-value	0.5182	0.9161	0.8943	0.9576	0.4418

Note: See table 4 for notes.

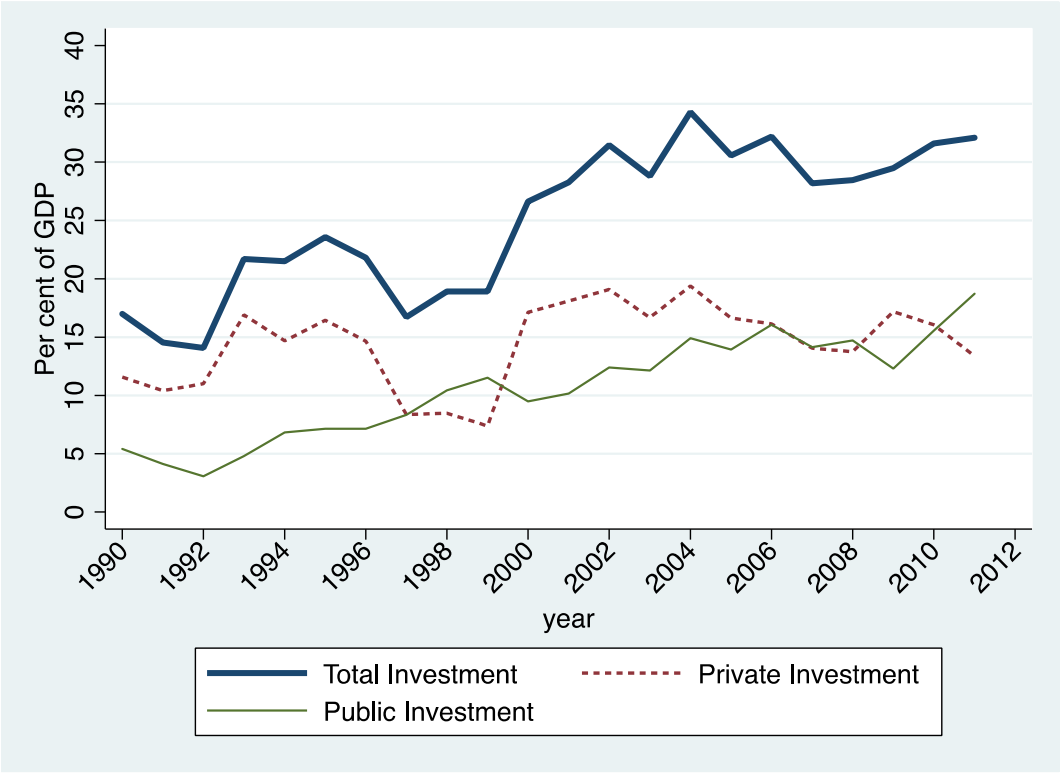

Figure 1: Trends and Composition of Investment in Ethiopia (per cent of GDP).
Source: World Development Indicators (2014)

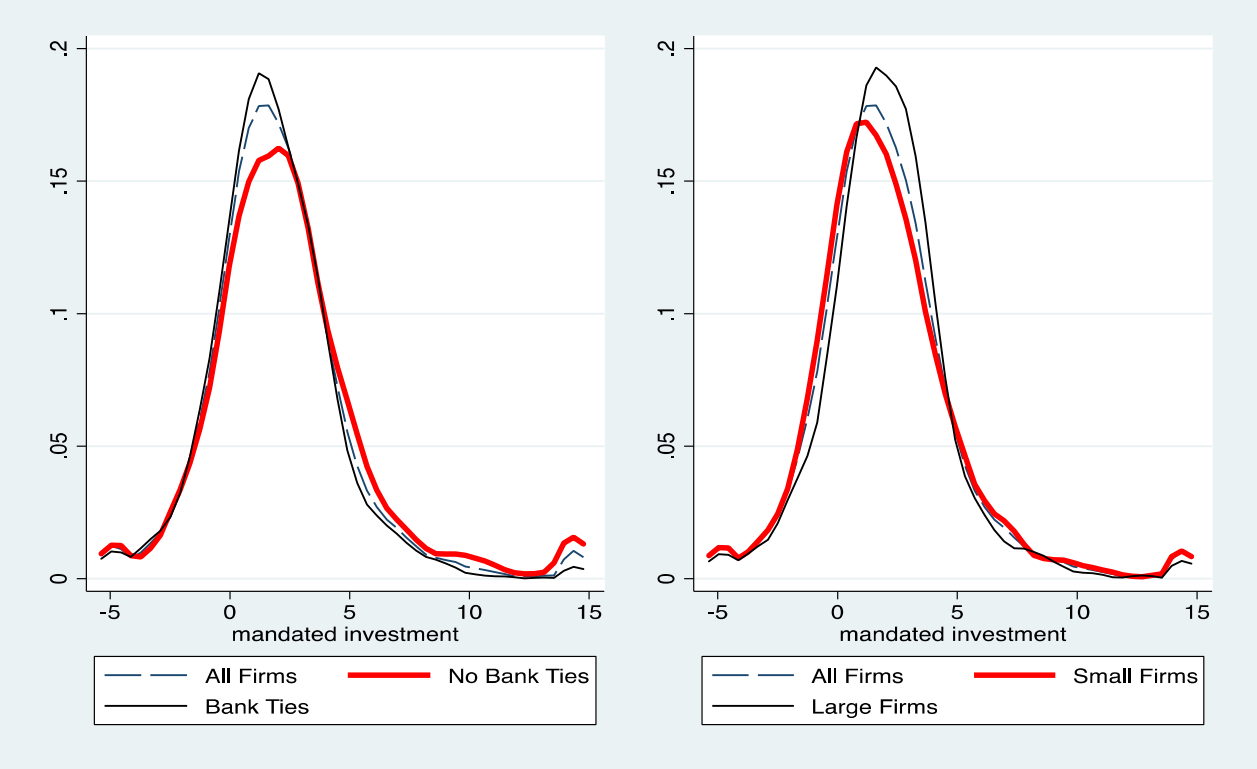

Figure 2: The Distribution of Mandated Investment (MI): Kernel Density Estimation

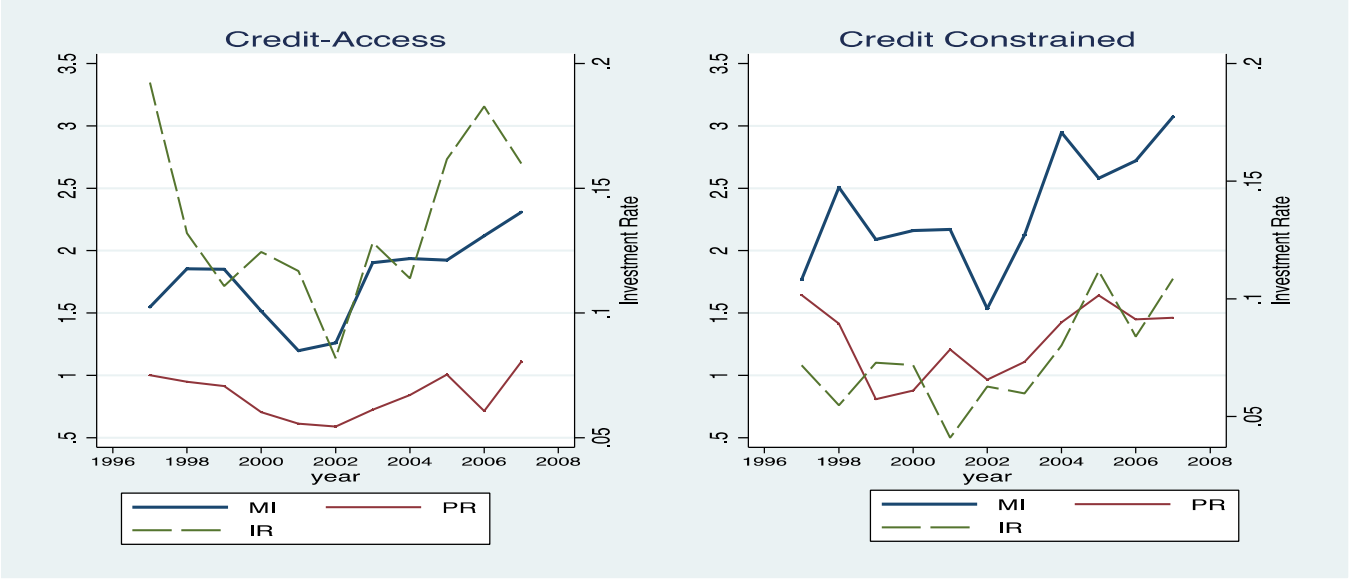

Figure 3: Trends in Mandated Investment (MI), Investment Rate (IR) and Profit Rate (PR). Note: IR is on the secondary y-axis while MI and PR are on primary axis.

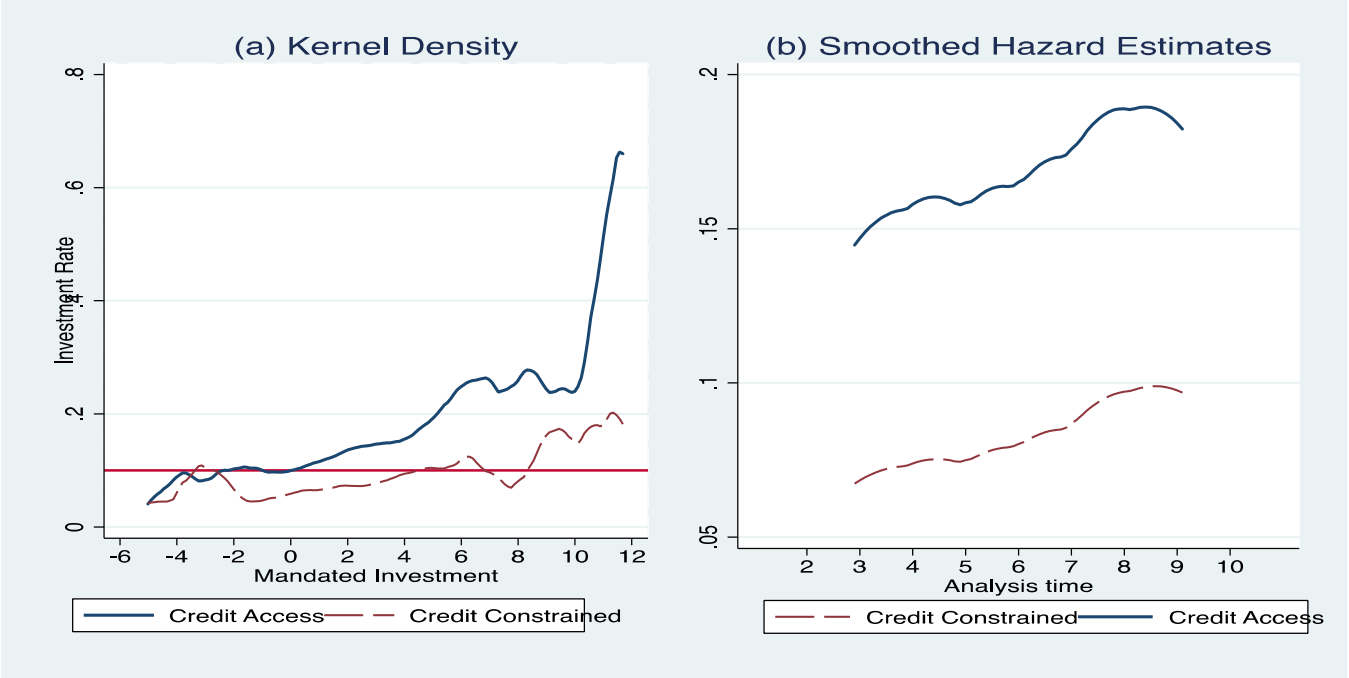

Figure 4: Average and lumpy investment using bank ties to proxy credit constraints.

Note: Panel (a) is based on the Nadaraya-Watson kernel density regression where the kernel function is epanechnikov.

Appendix

Appendix A: The Macroeconomic Context

Ethiopia returned to a more market based economy in 1991 after nearly two decades of a socialist regime. The economic reforms that began in 1992/93 involved *inter alia* trade liberalization, macroeconomic stabilization and exchange rate devaluation aiming to create a competitive and open investment climate. Restrictions on private sector participation were removed (including investment caps and sectors exclusively reserved for state-owned enterprises) while investment incentives were provided through tax holidays and duty free importation of capital goods. Moreover, the Ethiopian government committed itself to unprecedented investment efforts on economic infrastructure, education and health with financial support from international donors. After decades of neglect by the previous regime, agriculture also benefited from critical policy support not to mention favorable rainfall during most of the post-reform period. The economy gained strength during 1995 to 2002 with a 5 per cent annual average GDP growth and attained outstanding performance since 2003 as GDP grew annually by about 10 per cent on average, making it one of the fastest growing economies in Sub-Saharan Africa.[12]

[12] Ethiopia is touted as a potential manufacturing hub in East Africa in the coming decades in the textile and shoe industries where it may have a competitive advantage because of its large population (90 million people in 2012), growing educational attainment, and ever improving infrastructure.

There are, however, important challenges facing the Ethiopian economy. Despite its rapid growth, the economy remains heavily dependent on traditional agriculture with a 5 per cent GDP share of manufacturing in 2012. While aggregate investment increased from 15 per cent of GDP in the early 1990s to over 30 per cent of GDP since 2002/03, thereby fueling rapid economic growth, Figure 1 shows that this has been driven by a secular increase in public investment from about 5 per cent of GDP in the early 1990s to 17 per cent of GDP during 2011/12. In the meantime, private investment appeared to be volatile initially and then declined from about 17 per cent of GDP during 2002/03 to 14 per cent during 2011/12.[13]

Recent studies show that the depth of the Ethiopian financial sector and the quality of its services have a long way to go even by African standards. The sector remains completely closed off to foreign financial institutions and has only 16 privately owned domestic commercial banks as of 2015 accounting for less than 30per cent of the sector's financial assets (Zewdu, 2014). State-owned banks dominate the sector while the few private banks function under heavy regulation by financial authorities in the interest of financial stability, which seems to compromise financial intermediation. Moreover, a World Bank's (2015) review of Ethiopian financial institutions reveals exceptionally high collateral requirements (about 234per cent of the loan) that are particularly discouraging for small and medium enterprises (SMEs). Although a public credit bureau gathers data on credit worthiness, this database is not widely used by banks for screening loan applications.[14] In addition to stringent regulations and high collateral

[13] The gap between public and private investment in Ethiopia has also been emphasized by recent studies such as World Bank (2009), and Moller and Wacker (2015).
[14] It rather serves as a monitoring tool for financial authorities.

requirements, access to credit by private entrepreneurs appears to be seriously undermined by the rapid increase in public sector demand for credit to fund large-scale infrastructure development programs and the expansion of state-owned enterprises (World Bank, 2009).

The policy and regulatory environment continues to offer the state and state-owned enterprises a much better access to credit. A 2011 directive of the National Bank of Ethiopia (NBE) epitomized this disposition by mandating private banks to set aside 27per cent of every loan issued to private borrowers for purchasing NBE bills. Funds raised in this manner will be handed over to the state-owned Development Bank of Ethiopia for on lending to investors, native and foreign alike, in priority sectors at a lower interest rate.

Outstanding credit to the entire private sector, a widely used proxy for financial sector development, declined from 19per cent of GDP in 2004 to about 14per cent in 2011, which is far below the African average of 23per cent of GDP (World Bank, 2015). This trend seems consistent with the declining private investment to GDP ratio showed in Figure 1. The rest of the paper essentially provides a microeconomic perspective on this aggregate picture by exploiting across-firm variation in access to credit.

Given that more than half of formal manufacturing firms and the overwhelming majority of small firms are credit constrained, there appears to be a lot of room for improvement in private investment in Ethiopian manufacturing by improving access to credit for a broader group of entrepreneurs. Part of the problem is direct competition of the state, state-owned enterprises

and private enterprises for the same pool of loanable funds from a highly regulated and less efficient financial sector.

Appendix B: Econometric Model

The cointegrating relationship between actual and desired capital stock can be expressed as:

$$\log K_{it} = \gamma \log K_{it}^{*} + \varepsilon_{it} \qquad (1)$$

Following Caballero et al. (1995), we estimate the desired stock of capital K^{*} as:

$$K_{it}^{*} = K_{it-1}\left[\left(\frac{Y_{it}}{K_{it-1}}\right) C_{it}^{-\theta}\right]^{\eta_i}$$

where K_{it-1} is beginning of period capital stock, Y_{it} is current output and C_{it} is user cost of capital[15].

With logarithmic transformation we obtain the following expression for desired stock of capital:

[15] We calculated user cost as : $C_{it} = \frac{(r_t + \delta)\left(\frac{PI_t}{p_t}\right)}{(1-\tau)}$ where r is interest rate, δ is depreciation rate, τ is tax rate and *PI* and *P* are prices of capital goods and output, respectively.

$$\log K_{it}^{*} = \log K_{it-1} + \eta_i \left[\left(\log Y_{it} - \log K_{it-1} \right) - \theta_i \log C_{it} \right] \qquad (2)$$

For a production function with imperfect competition, Caballero et al.(1995) show that $\eta_i \approx 1/(1-\alpha_i)$ where α_i is the cost share of capital.

The cointegration equation in (1) implies an Error Correction Model (ECM) of the form:

$$\Delta \log K_{it} = \beta \Delta \log K_{it}^{*} - \phi \left(\log K_{i,t-1} - \gamma \log K_{i,t-1}^{*} \right) \qquad (3)$$

which consists of short-term growth in the desired stock of capital as well as correction for the deviation from an equilibrium relationship in the previous period.

We construct the time series of capital stock at the firm level using the perpetual inventory approach, i.e., $K_{it} = (1-\delta) K_{i,t-1} + I_{it}$ where I_{it} is investment spending net of capital disposal and δ is depreciation rate. We use the firm's book value of capital stock in the first year to construct its capital stock series accordingly.

Using the approximation that $\Delta \log K_{it} \approx \left(\frac{I_{it}}{K_{it-1}} \right)$, we get the following investment model:

$$\left(\frac{I_{it}}{K_{it-1}} \right) = \beta \left[(1-\eta_i) \left(\frac{I_{it-1}}{K_{it-2}} \right) + \eta_i \Delta \ln Y_{it} - \eta_{i\theta_i} \Delta \ln C_{it} \right] + \phi MI_{it-1} \qquad (4)$$

Where $MI_{i,t-1} = \gamma \log K^{*}_{i,t-1} - \log K_{i,t-1}$ is the error correction term. We will refer to it as *Mandated Investment* (MI) hereafter. The first term in big brackets is lagged investment rate, the second term is growth in sales and the third term is growth in user cost of capital.

Assuming observable components of user cost of capital are common to all firms, we can capture its effects on investment using time dummy variables as is widely practiced in this literature. Firm-specific responses to changes in user cost and investment opportunities can be represented by firm fixed effects. Since lagged investment is already a part of the production process, we assume its effect will be captured by $\Delta \ln Y_{it}$. This makes it redundant particularly for firms where η is close to one.[16]

The basic ECM investment model augmented with cash flow (π) and a composite error term can be expressed as:

$$\left(\frac{I_{it}}{K_{i,t-1}} \right) = a + \psi \Delta \log Y_{it} + \phi MI_{i,t-1} + \lambda \pi_{it} + \upsilon_i + e_t + u_{it} \qquad (5)$$

where v_i stands for firm fixed effects, e_t represents time fixed effects common to all firms and u_{it} is an identically distributed time varying random error term.

[16] Estimation results including lagged investment rate can be provided upon request from the author.

Cash flow is calculated by subtracting expenditures on intermediate inputs and wages from total revenue before tax. To test for the effects of uncertainty on investment we include volatility in the rate of change of profit $\left(\sigma_{it}^{\pi}\right)$. The latter is calculated by taking the standard deviation of profit growth over a three year window where profit growth is expressed as $\left(\pi_{it}-\pi_{it-1}\right)/0.5*\left(K_{it}+K_{it-1}\right)$. We also include a non-linear term in mandated investment to assess the investment response to very large capital shortfalls. The investment model we set out to test is thus:

$$\left(\frac{I_{it}}{K_{i,t-1}}\right)=a+\psi\Delta\ln Y_{it}+\phi_1 MI_{i,t-1}+\phi_2 MI_{i,t-1}^2+\lambda\pi_{it}+\varphi\sigma_{it}^{\pi}+e_i+v_t+u_{it} \qquad (6)$$

Appendix C:

Table C1: Distribution of Multiproduct Firms

Two Digit ISIC Industries (Grouped)	Number of 4 digit ISIC Industries	Number of Products	Fraction of Multiproduct Firms	Sales Share of Multiproduct firms
Food & Beverage	13	44	30.6	35.4
Food	9	35	34.7	54.3
Beverage	4	9	6.8	5.0
Textile & Garments	4	29	38.5	68.0
Textile	2	19	51.9	69.1
Garments	2	10	28.2	52.0
Leather & Footwear	2	12	25.3	55.1
Tannery	1	4	47.2	67.6
Footwear	1	8	18.9	20.6
Chemical & Plastic	7	22	23.7	51.9
Non-metal	5	10	41.9	11.7
Metal & Machinery	10	21	57.2	66.0
Total	41	138	33.9	42.0

Source: Annual Census of Ethiopian Manufacturing conducted by the Central Statistical Authority of Ethiopia (CSA).